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PHYSICAL REQUIREMENTS AND COSTS OF ESTABLISHING AND OPERATING A 200 ACRE FIELD NURSERY IN U.S.D.A. PLANT HARDINESS ZONES FIVE AND SIX

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Reed D. Taylor, Harold H. Kneen, Stanley Uchida
Elton M. Smith and David E. Hahn*

Department of Agricultural Economics
and Rural Sociology
The Ohio State University
Columbus, Ohio 43210

*Associate Professor, Department of Agricultural Economics and Rural Sociology, Ohio State University; Director of Marketing, Studebaker Nurseries, Inc., New Carlisle, Ohio; Former Graduate Student, Department of Agricultural Economics and Rural Sociology; Professor of Horticulture, and Professor of Agricultural Economics and Rural Sociology, Ohio State University.

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INTRODUCTION

To make more informed decisions as to whether to enter, leave, or expand field production, nurserymen require production, marketing and financial information. In this paper, a cost model for production of crops representing five categories of field-grown production schemes in U.S.D.A. Plant Hardiness Zones five and six is provided. Physical coefficients are included so the information can be readily updated and so individual nurserymen can use the model as a standard against which to compare their

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*Associate Professor, Department of Agricultural Economics and Rural Sociology, Ohio State University; Director of Marketing, Studebaker Nurseries, Inc., New Carlisle, Ohio; Former Graduate Student, Department of Agricultural Economics and Rural Sociology; Professor of Horticulture, and Professor of Agricultural Economics and Rural Sociology, Ohio State University. In addition to research, Drs. Taylor, Smith, and Hahn, hold appointments in the Ohio Cooperative Extension Service.

own operations or planned operations. Information derived should provide a basis for decision-making for those evaluating the profitability of establishing a new field nursery, or shifting from container to field production.

Production cost models have been developed for several species of plants in the Southern and North Central regions of the U.S. (1,2,3,4,5,6,8,9,10,11,12,13). Most of these models, while providing excellent information for individual species, did not attempt to develop comprehensive models for complete nursery operations. Taylor, et al., developed comprehensive models applicable to U.S.D.A. Plant Hardiness Zones 5 and 6 for both container- and field-grown crops representing, in each case, five categories of production schemes and two sizes of nurseries (14, 15). Badenhop and Phillips (7) developed a similiar study for field-grown crops in U.S.D.A. Plant Hardiness Zones 7 and 8 also representing five categories of field-grown production schemes and two sizes of nurseries. The purpose of this paper is to report on the larger field model developed by Taylor, et. al., for U.S.D.A. Plant Hardiness Zones 5 and 6.

OBJECTIVES

The general objective of this paper is to present the resources and costs associated with the establishment and operation of a model field nursery, including the delineation

of representative production systems. Specific objectives were to:

1. Model a series of production systems that would accomodate a majority of the species of plants being field-grown in U.S.D.A. Plant Hardiness Zones 5 and 6.
2. Analyze the important species of plants commonly grown in the field in U.S.D.A. Plant Hardiness Zones 5 and 6 and assign each of them to one of five designated groups based on similarities of growing and production requirements.
3. Choose one species from each group as representative of the group for detailed cost analysis.
4. Design physical facilities including land areas, land improvements, irrigation systems, buildings, machine and equipment components.
5. Develop costs budgets based on the modeled production systems, and physical production facilities.

MATERIALS AND METHODS

In the study, a model firm was synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in the model. It was synthesized based on the North Central region. If specific items were required (i.e. depth of well), coefficients were based on the Columbus, Ohio area. The complete synthesis included developing

an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with the purchase of plant liners and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs (15).

Data for this study were obtained from wholesale nurseries and nursery suppliers in the North Central region during the late Autumn and Winter of 1984 and the Spring of 1985. Price quotations obtained were for the 1985 production season. The basic goals in synthesizing the production facilities (see figures 1 and 2) were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and allow future expansion.

The nursery reported in this paper included 175 acres of growing space and 25 acres of production facilities, holding area, field bed area and roads.

Physical Plant and Equipment

Assumptions

Assumptions about the physical facilities and equipment can greatly affect its cost and thereby cost per salable plant. The authors included all items a nursery would typically require,

thus the physical plant is probably more elaborate than many nurserymen would require. A nurseryman can easily eliminate or reduce items as required. However, it would require substantial effort to do the analysis on his own if they were not included.

Scale of Nursery Operation. It was assumed the model field nursery would be self sufficient. Many field nurseries also have container operations with buildings, machinery and equipment being shared between operations.

Site. Land modifications costs could be reduced if the production facilities, holding area, and field-bed area were located on sandy soil with good natural drainage. Locating near a river or other natural water source could reduce or eliminate the need for a well.

Machinery and Equipment. Purchase of new machinery and equipment was assumed for the model nursery. Many nurserymen may choose to buy used equipment, rent equipment or time-share some expensive items with other nurseries

Enterprise Mix

We assumed that the model nursery would produce a diverse line of nursery stock. The length of the production cycle for the different species grown will vary. Five cultural groups were selected. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate to input costs

and cultural factors (Table 1). For analytical purposes, we assumed that each cultural group would occupy 20% of the growing area (35 acres per group). Annual sales capacity would be 90,867 plants (Table 2). For detailed analysis, one specific plant from each group was chosen as representative of the group. While it is recognized that other plants from each category would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the representative plant. The five groups (plant types chosen for detailed analysis are designated with a star) with some of their cultural characteristics are listed below:

Group	Plant	Cultural Characteristics
I.	SLOW GROWING EVERGREENS	
	*Taxus (species)	18-24" salable plant
	Buxus (species)	12" B&B
		10.2 sq. ft. of growing space per plant
II.	RAPID GROWING EVERGREENS	
	*Juniperus	18-24" salable plant
	chinensis (varieties)	12" B&B
	horizontalis (varieties)	10.2 sq. ft. of growing space per plant
	Pinus strobus	
	Thuja (species)	

III.	DECIDUOUS SHRUBS	
	*Viburnum (species)	18-24" salable plant
	Forsythia (species)	12" B&B
	Weigela (species)	11.9 sq. ft. of growing space per plant
	Ligustrum (species)	
IV.	SHADE TREES	
	*Acer rubrum (varieties)	2" caliper
	Acer platanoides (varieties)	24" B&B
	Fraxinus (species)	33.6 sq. ft. of growing space per plant
	Quercus (species)	
	Tilia (species)	
	Gleditsia (species)	
V.	ORNAMENTAL TREES	
	*Malus (flowering crab) (species)	5-6' (1 1/2 - 1 3/4" caliper)
	Prunus (Ornamental pluma) (species)	20" B&B 28.7 sq. ft. per plant

This mixture of plants material, would all be packaged in soil balls (balled and burlapped). Groups I, II, and III would be harveated by hand and Groups IV and V would require the assistance of a mechanical spade for harvesting.

Production Cost Budgets

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nursery were determined (Table 3). Second, capital requirements per salable plant capacity were established. Third, annual fixed costs were calculated (Table 4). Fourth, variable costs were determined (Table 5). Fifth, summaries were made for fixed and variable costs for each of the plant groups (Table 6). Sixth, total costs per salable plant were determined. This allowed cost comparisons based on cultural group.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis.

RESULTS AND DISCUSSION

Capital Investment Requirements

Capital investment requirements for establishing field nurseries were itemized under three broad divisions: land and

improvements, buildings, and machinery and equipment (Table 3). Each was further divided into several components. The nursery had an initial investment requirement of $1,379,236. Land and land improvements represented 50% or $684,210 of the investment, buildings 12% or $165,981, and machinery and equipment 38% or $529,045.

An important consideration for managers in most industries is determination of investment per unit of production capacity. For field nurseries this indicator would be the capital requirement per-salable-plant capacity. To determine this figure it was necessary to determine how many salable plants would be produced annually for each group in its allocated 20% of the growing space. This quantity ranged from a low of 8,177 for Group IV (Acer Rubrum) to 25,418 for Group III (Viburnum) (Table 2). The number of plants grown per unit of space directly relates to the capital requirements per-salable-plant. These capital costs differentiated by plant group were: $15.19 for Group I (Taxus), $10.85 for Group II (Junipers), $10.16 for Group III (Viburnum), $33.73 for Group IV (Acer Rubrum), and $23.07 for group V (Malus). The average for all groups was $15.18.

Although investment requirements for a 200 acre cost model field nursery for North Central conditions were examined, an infinite number of sizes could have been analyzed. Examination of the data indicate higher investment costs per unit of salable plant capacity would incur as field nursery size is decreased

from the 200 acre one analyzed. This would be caused by spreading the cost of fixed items such as buildings, equipment, and machinery over fewer units. Conversely, lower costs per unit of salable plant capacity would be realized for field nurseries larger than the 200 acre nursery analyzed as the costs of fixed items would be spread over more units.

Annual Costs

Fixed Costs. Fixed costs associated with capital investment (depreciation, interest, insurance and taxes) were $270,110 (Table 4). In addition there was $163,425 allocated for general overhead and $10,990 for interest on general overhead, insurance, and taxes resulting in a total of $444,525 fixed costs (Table 4). These costs were divided equally between the five plant groups, with each group receiving an assessment of $88,905 (Table 6).

On a per-salable-plant basis, there was a considerable difference in fixed costs when they were differentiated by plant group (Table 7). They were: $4.90 for Group I (Taxus), $3.48 for Group II (Juniperus), $3.27 for Group III (Viburnum), $10.87 for Group IV (Acer rubrum), and $7.43 for Group V (Malus) and averaged $4.88 for all groups (Table 7). Fixed costs as a percent of total costs ranged from 30% to 52% and averaged 39% for all groups (Table 7).

Variable Costs. Variable costs are detailed in Table 5. Total variable costs by plant group were $81,524 for Group I (Taxus), $91,659 for Group II (Juniperus), $103,262 for Group III

(Viburnum), $202,260 for Group IV (Acer rubrum), and $206,687 for Group V (Malus). Total for all groups was $685,392 (Table 6). On a per-salable-plant basis variable costs were $4.49 for Group I, $3.61 for Group II, $3.80 for Group III, $24.74 for Group IV, $17.30 for Group V and averaged $7.55 for all groups (Table 7). Variable costs ranged from 48% to 70% of total cost and averaged 61% for all groups.

Total Costs. Total annual costs are the summation of fixed and variable costs. They were $170,429 for Group I (Taxus), $180,564 for Group II (Juniperus), $192,167 for Group III (Viburum), $291,165 for Group IV (Acer rubrum), and $295,592 for Group V (Malus). They totaled $1,129,917 for all groups (Table 6). On a per-salable-plant basis total costs were $9.39 for Group I, $7.09 for Group II, $7.07 for Group III, $35.61 for Group IV, and $24.73 for Group V and averaged $12.43 for all groups (Table 7).

Individual nurserymen might well experience costs different than those depicted here. Most cost differences would probably be reflected in fixed rather than variable costs. Budgets presented assumed new facilities, machinery, and equipment. Most nurserymen have owned their land for many years and have used machinery and equipment. For the established nursery, budgeted fixed costs presented here would reflect replacement rather than"book values" of depreciated items. Interest on investment items was also determined using the approximate rate charged by banks. Another method of computing interest charges would be to

use the "real" rate which is the difference between what a bank charges and the rate of inflation (i.e. 12% bank rate of interest - 5% rate of inflation = 7% real interest rate). Yet another method of computing interest would be to use the "real" interest rate computed on 50% of the cost of depreciable items. This latter method takes into account the "real" rate of interest and cost recovery of depreciable items. We choose the method we felt was most understandable to the majority of nurserymen. It does, however, overstate the cost of interest in most cases. Variable cost items, on the other hand, should be rather consistent regardless of age and size of nursery.

SUMMARY AND IMPLICATIONS

Total annual costs per salable plant differentiated by species ranged from $7.07 to $35.61 and averaged $12.43 for all species. Fixed costs per salable plant ranged from $3.27 to $10.87 and averaged $4.88. Fixed costs as a percentage of total costs ranged from 30% to 52% and averaged 39%. Variable costs per salable plant showed substantial differences among plant species. They ranged from $3.61 to $24.74 and averaged $7.55. Major differences among species affecting variable costs were labor, and the cost of liners in the case of trees. Variable costs as a percentage of total costs ranged from 48% to 70% and averaged 61%.

Implications

A comparison of total costs of producing "B & B" plants in a 200 acre nursery in the field in U.S.D.A. Plant Hardiness Zones 5 and 6 with prices in producers' wholesale catalogs would, at best, show marginal returns. In fact, if one were to add costs of selling, very few producers would presently be charging enough to cover all costs, let alone profits. How then can producers continue to operate? The answer lies in how producers both experience and compute costs. We have used the economic and accounting method which includes both explicit and implicit costs. Explicit costs are those that are paid directly and easily determined, e.g. cost of liners, soil media, polyethylene, chemicals, labor, etc. Implicit costs are those that are more difficult to determine, such as the cost of equity capital and implied managerial salaries. The way these costs are determined varies significantly from firm to firm. Well-established nurseries are usually very accurate in determining explicit costs, but often do not consider all implicit costs. They base their costs on "cash flow" and profit and loss on "tax accounting". These established nurseries may have purchased land at low cost, be working with depreciated equipment and may be assigning low if any value to their management; in this case determined costs would be at a much lower level than presented in this paper. Also, as pointed out earlier, careful site selection could significantly reduce fixed (overhead) costs. However, if one were to start a new field nursery, in a "normal" U.S.D.A.

Plant Hardiness Zone 5 or 6 site, costs would probably be very close to those presented here.

For the industry, selling nursery product below "accounting costs" implies that well-established nurseries, operating essentially debt free, would have strong staying power whereas those who have just started or are heavily in debt may not be able to survive especially if they are relying on their field operation to meet all overhead expenses. Second, starting a field nursery (unless it were quite large) in U.S.D.A. Plant Hardiness Zones 5 and 6 would probably not prove profitable unless items like buildings, equipment, machinery, management, etc., could be shared with other enterprises or unless selling prices of nursery products in the Zones increased substantially. At current prices for nursery products, this study shows that the return on investment for establishing new, independently operating, field nurseries in U.S.D.A. Plant Hardiness Zones 5 and 6 would be marginal if not negative.

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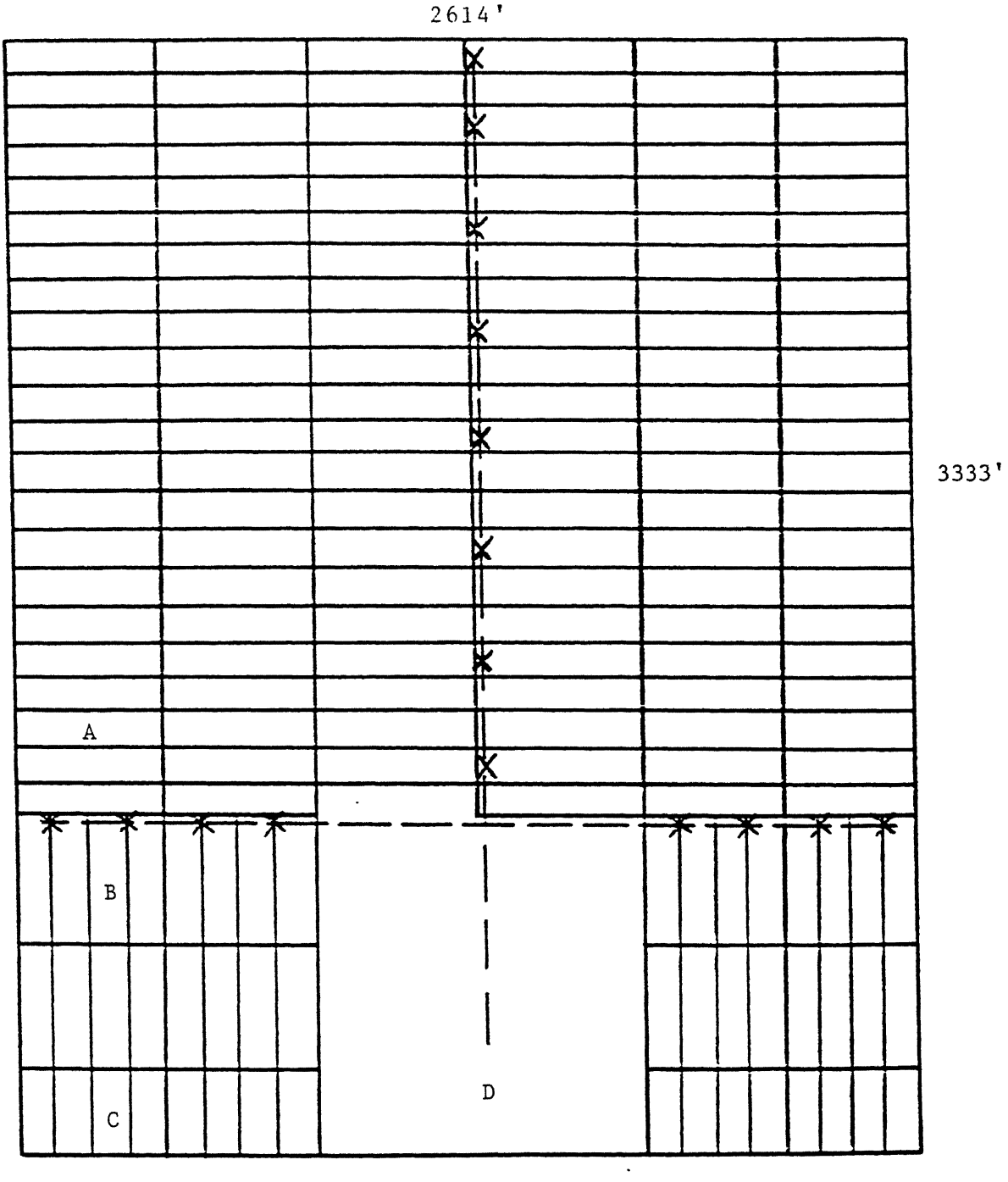
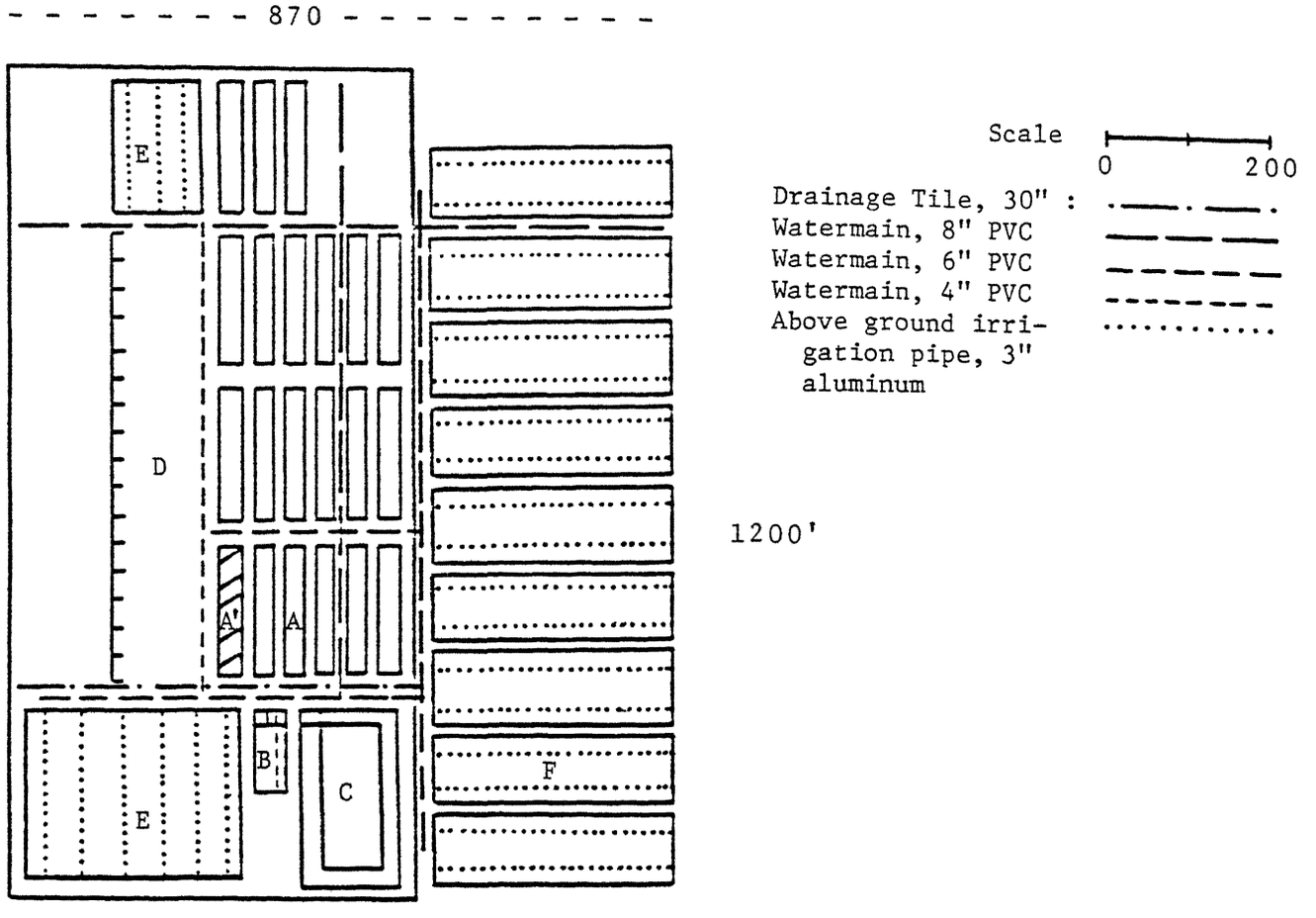
FIG. 1 - Schematic Drawing of a 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six.



A. Growing plots (131) 100.0' x 435.6' (one acre)
B. Growing plots (32) 108.9' x 400.0' (one acre)
C. Growing plots (16) 108.9' x 300.0' (3/4 acre)
D. Production facilities, holding area, and field-bed area, 870' x 1200' (Note: one acre from this area was used as a growing plot.

X Denotes placement of water hydrants for irrigation.
8" PVC pipe —— —— ——

FIG. 2 - A Schematic Drawing of a 200 Acre Field Nursery's Production Facilities, Holding Area, and Field-Bed Area, U.S.D.A. Plant Hardiness Zones Five and Six. (Detail of Area D of Figure 1)



A. Polyhouse structure, 20 each (20' x 200') = 80,000 sq. ft. = 1.84 acres
A'. Propagation house, 1 each (20' x 200) = 4,000 sq. ft. = .09 acres
B. Supply shed, machinery storage, machine shop (40' x 100')
Office and restrooms (20' x 40')
C. Pond, (80' x 220' x 14' depth), Pump house, (10' x 10')
D. Shipping area, (10 semitruck loads)
E. Holding area, (240' x 280') and
(200' x 64') = 80,000 sq. ft. = 1.84 acres
F. Liner bed area, 9 each (100' x 330') = 297,000 sq. ft. = 6.82 acres

Total Acreage, 870' x 1200' = 1,044,000 sq. ft. = 23.97 acres

TABLE 1.--Plant Densities and losses for Field Production of Nursery Plants, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Group	Description	Size of Salable Plant	Years in Rotation	Spacing Between Rows	Spacing In Rows	Sq. Ft. Per Plant*	Plants Per Acre	Est. Percent Loss**
I	Slow Growing Evergreens - Taxus	18-24"	7	44"	28"	10.2	4,272	15
II	Fast Growing Evergreens - Juniperus	18-24"	5	44"	28"	10.2	4,272	15
III	Deciduous Shrubs - Viburnum	3-4'	4	48"	30"	11.9	3,652	15
IV	Shade Tree - Acer Rubrum	2" dia.	5	96"	42"	33.6	1,298	10
V	Ornamental Tree - Malus	5-6'(1 1/2")	4	96"	36"	28.7	1,518	10

*Sq. ft. per plant includes necessary perimeter roads.

**Assume 1/2 of loss between first and second year and remainder in last year of production. Losses in the last year of production would be left in the field.

TABLE 2.--Planting and Harvesting Requirements for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Plant Group	Description	Propagation** Units Stuck	Bedding Area*** Rooted Cuttings Planted	Field Planting Acres	Acres Planted Per Year	Units Planted Per Year	Units Harvested Per Year****
I	Slow Growing Evergreens - Taxus	37,710	26,700	35	5.00	21,360	18,156
II	Fast Growing Evergreens - Juniperus	48,594	37,380	35	7.00	29,904	25,418
III	Deciduous Shrubs - Viburnum	51,927	39,944	35	8.75	31,955	27,162
IV	Shade Tree - Acer Rubrum*****	-	-	35	7.00	9,086	8,177
V	Ornamental Tree - Malus*****	-	-	35	8.75	13,283	11,954
	Total	138,231	104,024	175	36.50	105,588	90,867

*200 total acres with 175 acres in field growing space, and 25 acres in production facilities, holding area, field bed area, roads, etc.

**For each plant available for transplanting as a rooted cutting into the bedding area, it is estimated that 1.3 cuttings would need to be stuck in the propagation facility.

***For each plant available for transplanting into the field, it is estimated that 1.25 rooted cuttings would need to be planted in the bedding area.

****Assume 1/2 dug in Fall for Fall sales and overwintering and 1/2 dug in the Spring.

*****Shade and Ornamental Trees would be purchased as bare root liners for planting directly into the field.

TABLE 3.--Capital Requirements for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	acre	--	200	2,000	400,000	29
+ Improvements	Grading, tiling, graveling, pond		20			284,210	21
Subtotal						684,210	50
Buildings							
Office and restrooms	20' x 40'	sq ft	20	800	35	28,000	2
Plant and supply storage	40' x 50'	sq ft	20	2000	20	40,000	3
Machinery storage and shop	40' x 50'	sq ft	20	2000	20	40,000	3
Polyhouse structures	200' x 20'	each	10	21	2,761	57,981	4
Subtotal						165,981	12
Machinery and Equipment							
Tractor, 100 HP	100 HP, diesel fuel	each	10	1	28,278	28,278	2
Tractor, 60 HP	60 HP, diesel fuel	each	10	1	20,419	20,419	1
Tractor, 34 HP	34 HP, gas fuel	each	10	4	14,504	58,016	4
Articulated 4-Wheel Drive Loader	Swinger 220 - Lift cap. = 2,000 lbs.	each	10	2	25,000	50,000	4
Articulated 4-Wheel Drive Loader	Swinger 320 - lift cap. = 3,000 lbs.	each	10	2	38,000	76,000	6
Tree spade	530P Handles 20",22", & 24" + liftpads	each	2	2	8,490	16,980	1
Forks	For front-end loaders	each	10	4	1,100	4,400	**
Plow	3-14 inch plows	each	10	1	2,616	2,616	**
Disk	8' wide	each	10	1	3,900	3,900	**
Harrow	10' wide	each	10	1	650	650	**
Cultimulcher - bed area	10' wide	each	10	1	3,800	3,800	**
Sprayrig (boom sprayer)	100 gallon tank with 7' & 10' booms	each	7	1	1,407	1,407	**
Transplanter, 3 row	3-20 inch row bed transplanter	each	10	1	7,500	7,500	1
Transplanter, 1 row	Tree planter	each	10	1	5,000	5,000	**
Permanent irrigation/well pump	100HP electric pump	each	20	1	36,396	36,396	3
Inground irrigation/bed area	PVC pipe/valves		20		34,606	34,606	3
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads		5		4,347	4,347	**
Inground irrigation storage/holding	PVC pipe/valves		20		17,959	17,959	1
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads		5		8,286	8,286	1
Traveler gun - field irrigation	450-500 gallons per minute		10	1	22,000	22,000	2
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	each	10	1	425	425	**
Airblast sprayer	Myer - 300 gallon HP on trailer	each	7	1	3,600	3,600	**
Fertilizer injector	26 gallon injector	each	5	2	858	1,716	**
Transplanter, 2 row	2-42/48" row field transplanter	each	10	1	5,600	5,600	**
U Blade - field	18" for undercutting	each	5	1	240	240	**
Undercutter - bed	Bed undercutter, 50" blade, lift tines	each	7	1	285	285	**
Fertilizer sidedresser	2 row sidedresser	each	10	1	1,000	1,000	**
Cultivator, 2 row	2 row field cultivator	each	7	2	1,750	3,500	**
Wagon	4 wheel, farm wagon	each	10	8	1,978	15,824	1
Cultivator, 3 row	3 row bed cultivator	each	7	1	2,250	2,250	**
Truck	1/2 ton pickup truck	each	5	2	13,485	26,970	2

Table 3 Cont.

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Pallets	Wooden	each	2	482	12	5,784	**
Handtools	Miscellaneous	sets	5	76	100	7,600	1
Seeder	Broadcast Seeder		10	1	175	175	**
Mower	7' - 3 blade mower		10	1	2,283	2,283	**
Flatbed Truck	24 ft. flatbed, gas fuel		5	1	42,000	42,000	3
Heating system for propagation							
Gas fired unit heater - Modine	200,000 BTU (input)	each	10	2	1,104	2,208	**
Fan jet - Acme		each	10	2	103	206	**
Thermostat	Two stage	each	10	2	44	88	**
Set-up for propane***	Vent., reg., etc.	each	10	2	100	200	**
Set-up for heating system	Plywood, braces, bolts, etc.	each	10	2	100	200	**
Other propagation materials						1,494	
Misting system	Mist-a-matic	each	2	6	249	494	**
Pipe and nozzles	For misting system		2	2	300	600	**
Treated boards	5/4" x 8" x variable length	foot	2	1,320	0.74	977	**
Heating cable	Propagation	foot	2	3,600	0.35	1,260	**
Subtotal						529,045	38
TOTAL						1,379,236	100

*Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.
**Less than 1/2 of 1%.
***Propane tanks, connectors, etc. will be leased from the company supplying propane.

Table 4.--Annual Fixed Costs (Dollars) for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Land	Unimproved land	---	48,000	8,000	56,000
+ Improvements	Grading, tiling, graveling, pond	12,789	34,105	5,684	52,578
Subtotal		12,789	82,105	13,684	108,578
Buildings					
Office and restrooms	20′ x 40′	1,260	3,360	685	5,305
Plant and supply storage	40′ x 50′	1,800	4,800	978	7,578
Machinery storage and shop	40′ x 50′	1,800	4,800	978	7,578
Polyhouse structures (21 ea)	200′ x 20′	5,218	6,958	1,418	13,594
Subtotal		10,078	19,918	4,059	34,055
Machinery and Equipment					
Tractor, 100 HP	100 HP, diesel fuel	2,545	3,393	107	6,045
Tractor, 60 HP	60 HP, diesel fuel	1,838	2,450	77	4,365
Tractor, 34 HP (4 ea)	34 HP, gas fuel	5,221	6,962	219	12,402
Articulated 4-Wh. Dr. Loader (2 ea)	Swinger 220 - lift cap. = 2,000lbs	4,500	6,000	189	10,689
Articulated 4-Wh. Dr. Loader (2 ea)	Swinger 320 - lift cap. = 3,000lbs	6,840	9,120	287	16,247
Tree spade (2 ea)	530P Handles 20",22", & 24" + liftpads	7,641	2,038	64	9,743
Forks	For front-end loaders	396	528	17	941
Plow	3 - 14 inch plows	235	314	10	559
Disk	8′ wide	351	468	15	834
Harrow	10′ wide	59	78	2	139
Cultimulcher - bed area	10′ wide	342	456	14	812
Sprayrig (boom sprayer)	100 gallon tank with 10′ boom	181	169	5	355
Transplanter, 3 row	3-20 inch row bed transplanter	675	900	28	1,603
Transplanter, one row	Tree planter	450	600	19	1,069
Permanent irrigation/well pump	100 HP electric pump	1,638	4,367	138	6,143
Inground irrigation/bed area	PVC pipe/valves	1,557	4,153	131	5,841
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads	782	522	16	1,320
Inground irrigation storage/holding	PVC pipe/valves	808	2,155	68	3,031
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads	1,491	994	31	2,516
Traveler gun - field irrigation	450-500 gallons per minute	1,980	2,640	83	4,703
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	38	51	2	91
Airblast sprayer	300 gallon high pressure on trailer	463	432	14	909
Fertilizer injector (2 ea)	26 gallon injector	307	205	6	518
Transplanter, 2 row	2-42 inch row field transplanter	504	672	21	1,197
U-Blade - field	18" for undercutting	43	29	1	73
Undercutter - bed	Bed undercutter, 50" blade, lift tines	37	34	1	72
Fertilizer sidedresser	2 row sidedresser	90	120	4	214
Cultivator, 2 row (2 ea)	2 row field cultivator	450	420	13	883
Wagon (8 ea)	4 wheel, farm wagon	1,424	1,899	60	3,383
Cultivator, 3 row	3 row bed cultivator	289	270	9	568
Truck (2 ea)	1/2 ton pickup truck	4,855	3,236	102	8,193
Pallets (482 ea)	Wooden	2,603	694	22	3,319
Handtools (76 Sets)	Miscellaneous	1,368	912	29	2,309
Seeder	Broadcast seeder	16	21	1	38
Mower	7′ - 3 blade mower	205	274	9	488

Table 4 Con't

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Flatbed truck	24 ft. flatbed, gas fuel	7,560	5,040	159	12,759
Heating System for Propagation					
Gas fired unit heaters (2 ea)	200,000 BTU (input)	199	265	8	472
Fan jet - Acme (2 ea)		19	24	1	44
Thermostat (2 ea)	Two stage	8	11	#	19
Set-up for propane (2 ea)	Vent., reg., etc.	18	24	1	43
Set-up for heating system (2 ea)	Plywood, braces, bolts, etc.	18	24	1	43
Other Propagation Materials					
Misting system (6 ea)	Mist-a-matic	672	179	6	857
Pipe and nozzles	For misting system	270	72	2	344
Treated boards	5/4" x 8" x variable length	440	117	4	561
Heater cable		567	151	5	723
Subtotal		61,993	63,483	2,001	127,477
Total for Depreciation, Interest Insurance and Taxes		84,815	165,386	19,740	270,110
General Overhead					
Utilities	Telephone, electric, gas heat				9,200
Licenses and bonds					600
General repairs and maintenance	Buildings, grounds, roads				12,200
Advertising and printing					1,800
Insurance, personnel##	Workmen's comp., FICA, health, unemp.				30,400
Travel and professional fees					2,725
Administrative and management###	Clerical, operator, supervisory, labor and office supplies				104,500
Miscellaneous					2,000
Subtotal					163,425
Interest on General Overhead Insurance, and Taxes	12% per annum for 6 months on a total of $183,169				10,990
Total Annual Fixed Costs					444,525

*Two hundred acre total, 175 acres growing space, 25 acres production facilities, holding area, field bed area, roads, etc.

**Depreciation was estimated by dividing initial cost adjusted for a 10% salvage value, by the years of useful life.

***Interest costs were estimated by multiplying the initial value of land, building, equipment and machinery by the interest rate, 12% per annum.

****Insurance and taxes.

Land and improvements--Only taxes are assessed, at a rate of $20.00 per $1000.00 of market value.

Buildings--Taxes are assessed at a rate of $20.00 per $1000.00 of market value. Insurance, $500.00 deductible, at $4.46 per $1000.00 of market value. Total for category, $24.46 per $1000.00.

Machinery and equipment--Taxes are not assessed in state of Ohio on personal property. Insurance, $500.00 deductible, at $3.78 per $1000.00 of initial value.

#Less than $0.50.

##Insurance for personnel was estimated at 32% of salaries for owner/operator, supervisors, and clerical.

###Owner/operator = $35,000, 2 Supervisors @ $20,000 ea. = $40,000, 2 Clerical @ $10,000 = $20,000, Supplies 10% or $9,500. Total = $104,500.

TABLE 5.--Variable Costs (Dollars) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	66.00	429
Collecting, stripping & sticking	135,231 units	hrs.	6.93****	152.78	1,059
Maintainance		hrs.	6.93	800.00	5,544
Harvest	135,231 units	hrs.	6.93	289.97	2,010
Hormone powder	#1, I.B.A. (Viburnum)	lbs.	8.00	1.49	12
	#3, I.B.A. (Juniperus)	lbs.	11.70	1.39	16
	#8, I.B.A. (Taxus)	lbs.	15.50	1.08	17
Subtotal					9,087
Materials					
Burlap	32" x 32" squares + twine (shrubs)	each	0.45	70,736.00	31,831
	54" x 54" squares-24" basket (Acer rubrum)	each	3.10	8,177.00	25,349
	54" x 54" squares-18" basket (Malus)	each	2.53	11,954.00	30,244
Twine	Nails & twine (trees)	each	0.15	20,131.00	3,020
Liners	Acer rubrum, 6-8' 2 yr branched	each	8.68	9,086.00	78,866
	Malus, 5-6' 2 yr branched	each	4.86	13,283.00	64,555
Polyethylene film	4 mil white, 32' x 225' (shrubs overwinter)	each	127.50	17.68	2,254
Strip tags	5/8" X 7" plastic strip tag	each	0.02	90,867.00	1,817
Poultry wire	1" for rabbit control (trees)	roll	29.00	18.00	522
Seed	Rye grass (Kentucky 31) (trees)	pound	0.64	3,430.35	2,195
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	21.96	3,865
	Custom spread, (lime)	ton	20.00	35.53	711
	Urea, 45-0-0 (fertilizer)	ton	220.00	20.27	4,459
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	1.35	1,905
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	16.29	546
	Simazine 80WP (Princep) (herbicide)	pound	3.75	366.11	1,373
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	999.30	6,366
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	323.10	5,906
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	271.20	3,843
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	459.65	2,799
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	53.00	93
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				6,308
Subtotal					278,827
Machinery and Equipment					
	Tractor, 100 HP	hour	17.00	493.33	8,387
	Tractor, 60 HP	hour	11.68	583.16	6,811
	Tractor, 34 HP	hour	4.99	631.20	3,150
	Articulated Loader/2,000lbs	hour	6.67	524.58	3,499
	Articulated Loader/3,000lbs	hour	14.81	525.17	7,778
	Tree Spade	hour	5.30	1,018.23	5,397
	Forks	hour	0.01	1,044.01	10
	Plow, 3-14"	hour	6.57	31.12	204
	Disk, 8' wide	hour	4.23	59.23	251
	Harrow, 10' wide	hour	8.45	4.66	39
	Cultimulcher, 10' wide	hour	24.70	8.76	216

Table 5 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Spray rig with 10′ boom	hour	2.77	57.04	158
	Transplanter, one row (tree)	hour	0.92	406.71	374
	Transplanter, 3 row	hour	26.79	20.81	557
	Permanent irrigation/well & pump 100 HP	hour	7.60	323.00	2,455
	Inground irrigation - bed/field area	hour	3.13	221.50	693
	Above ground irrigation - bed area	hour	1.83	190.00	348
	Inground irrigation - storage & holding	hour	5.65	60.00	339
	Above ground irrigation - storage & hold.	hour	11.05	60.00	663
	Traveler gun	hour	12.06	73.00	880
	Portable PTO pump, 40 HP (emergency)	hour	3.75	3.40	13
	Airblast sprayer	hour	1.01	405.15	409
	Fertilizer injector	hour	12.39	9.00	112
	Seeder	hour	1.05	10.72	11
	Mower	hour	2.98	42.84	128
	Transplanter, 2 row	hour	12.00	34.67	416
	Undercutter, bed	hour	1.16	20.00	23
	U Blade	hour	17.56	1.65	29
	Sidedresser, 2 row	hour	0.63	101.25	64
	Cultivator, 2 row	hour	.95	171.48	163
	Wagon, 4 wheel	hour	0.48	248.80	119
	Cultivator, 3 row	hour	13.93	14.75	205
	Truck, 1/2 ton pickup	hour	8.42	2,779.10	23,402
	Flatbed truck, 24′ bed	hour	14.87	1,701.74	25,305
Subtotal					92,608
Labor					
	Labor hours	hour	6.93****	31,995.24	221,727
	Related labor hours, 20%	hour	6.93	6,399.28	44,347
Subtotal					266,074
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	646,596.00	38,796
Total Variable Costs					685,392

*Total Nursery - 200 acres; 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.,
**Quantity discounts were applied to chemicals and other items.
***135,231 plants would be stuck in the propagation house where about 23% would be lost leaving 104,024 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost leaving 83,219 for transplanting into the field.
****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.
*****To achieve better pest and disease control, alternative chemical useage is advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 6.--Summary of Fixed, Variable and Total Costs (Dollars) of Operating a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)	Group II (Juniperus)	Group III (Viburnum)	Group IV (Acer rubrum)	Group V (Malus)	Total
Fixed Cost						
Land and improvements	21,716	21,716	21,716	21,716	21,716	108,578**
Buildings	6,811	6,811	6,811	6,811	6,811	34,055**
Machinery and equipment	25,495	25,495	25,495	25,495	25,495	127,477**
General overhead	32,685	32,685	32,685	32,685	32,685	163,425**
Interest on general overhead, insurance, and taxes	2,198	2,198	2,198	2,198	2,198	10,990**
Subtotal	88,905	88,905	88,905	88,905	88,905	444,525**
Variable Costs						
Propagation	3,560	2,713	2,814	***	***	9,087
Materials	17,070	19,561	20,875	113,506	107,815	278,827
Machinery and equipment	11,739	12,039	14,138	24,747	29,945	92,608
Labor	44,540	52,158	59,590	52,558	57,228	266,074
Interest on operating capital	4,615	5,188	5,845	11,449	11,699	38,796
Subtotal	81,524	91,659	103,262	202,260	206,687	685,392
TOTAL	170,429	180,564	192,167	291,165	295,592	1,129,917**
Salable Plants per Year	18,156	25,418	27,162	8,177	11,954	90,867
Cost per Salable Plant	9.39	7.10	7.07	35.61	24.73	12.43

*Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.
**Individual figures do not always add to the total due to rounding.
***Tree liners were purchased rather than prapogated. Liner costs were included under materials.

TABLE 7.--Summary of Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)		Group II (Juniperus)		Group III (Viburnum)		Group IV (Acer rubrum)		Group V (Malus)		Average	
	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	1.20	(13)	.85	(12)	.80	(11)	2.66	(7)	1.82	(7)	1.19	(10)
Buildings	.38	(4)	.27	(4)	.25	(4)	.83	(2)	.57	(2)	.37	(3)
Machinery and Equipment	1.40	(15)	1.00	(14)	.94	(13)	3.11	(9)	2.13	(9)	1.40	(11)
General Overhead	1.80	(19)	1.28	(18)	1.20	(17)	4.00	(11)	2.73	(11)	1.80	(14)
Interest on General Overhead, Insurance, and Taxes	.12	(1)	.08	(1)	.08	(1)	.27	(1)	.18	(1)	.12	(1)
Subtotal	4.90	(52)	3.48	(49)	3.27	(46)	10.87	(30)	7.43	(30)	4.88	(39)
Variable Cost Items												
Propagation	.20	(2)	.11	(1)	.10	(1)	**		**		.10	(1)
Materials	.94	(10)	.77	(11)	.77	(11)	13.88	(39)	9.02	(37)	3.07	(25)
Machinery and Equipment	.65	(7)	.47	(7)	.52	(8)	3.03	(9)	2.51	(10)	1.02	(8)
Labor	2.45	(26)	2.05	(29)	2.19	(31)	6.43	(18)	4.79	(19)	2.93	(24)
Interest on Operating Capital	.25	(3)	.21	(3)	.22	(3)	1.40	(4)	.98	(4)	.43	(3)
Subtotal	4.49	(48)	3.61	(51)	3.80	(54)	24.74	(70)	17.30	(70)	7.55	(61)
Total Costs per Salable Plant	9.39	(100)	7.09	(100)	7.07	(100)	35.61	(100)	24.73	(100)	12.43	(100)

*Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.
**Tree liners were purchased rather than propagated. Liner costs were included under materials.